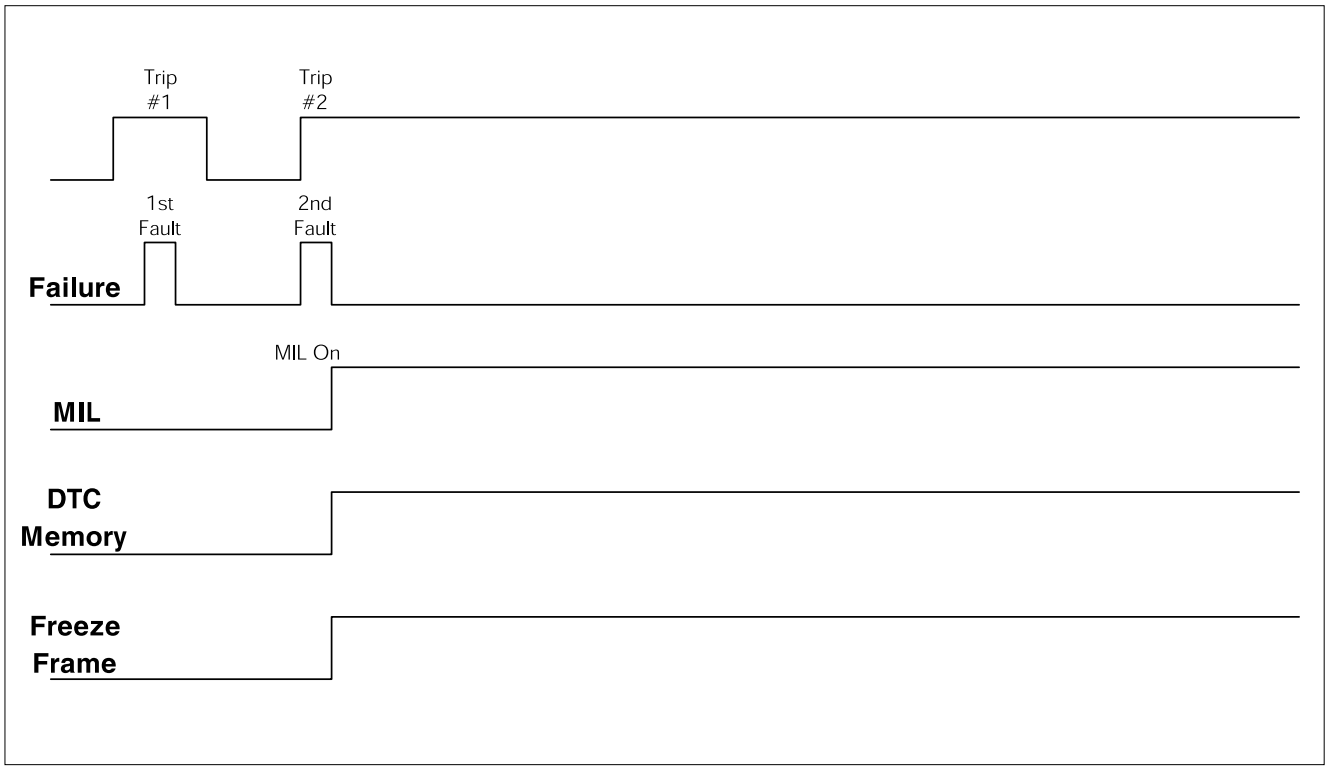
On-Board Diagnostic Systems



Learning Objectives:

1. Determine status of OBD II controlled systems based on MIL status.
2. Determine status of OBD II Readiness Tests Monitors using CARB mode.
3. Interpret OBD II SAE Powertrain DTC nomenclature.
4. Identify OBD II Scan Tool modes and apply these modes to a diagnostic routine.

Section 2

On-Board Diagnostic Systems

Overview

On-Board Diagnostic (OBD) systems use the vehicle's computer(s) to detect problems with components or systems and report these problems to driver and technician. Engine OBD systems are, in part, governed by regulations and divided into two major categories:

- OBD I
- OBD II (phased in beginning 1996 MY)

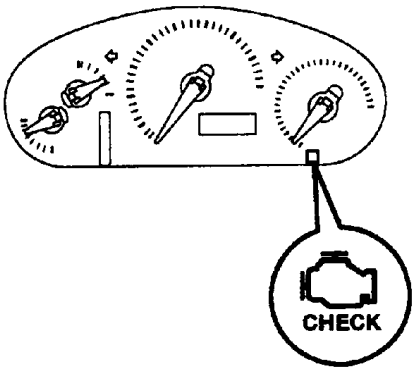
In 1988, the California Air Resources Board (CARB) set the requirement that all vehicles have a system that could identify faults in the emission and powertrain system. This is recognized as OBD I.

At the same time, CARB also set the requirements for OBD II. The Federal government adopted these requirements and they went into effect beginning in 1996. OBD II standards greatly enhanced the On-Board diagnostic system's capabilities and changed the way technicians troubleshoot engine and emission control systems.

In either case, the manufacturer can provide additional diagnostic capabilities. For the technician, understanding what the OBD system is capable of and its limitations will help in fixing vehicles right the first time.

OBD systems report data to the technician by a Malfunction Indicator Lamp (MIL) located in the instrument cluster and Diagnostic Tester.

OBD I Regulations



- Current related checks (open or short)
- Limited system monitoring (A/F & EGR)
- Minimal use of rationality checks
- Limited DTC(s)
- Limited use of Serial data
- System and component names not standardized
- DTC(s) not standardized

Fig. 2-1
TL874f201

OBD I (On-Board Diagnostic System, (Generation 1)

In April 1985, the California Air Resources Board (CARB) approved On-Board Diagnostic system regulations, referred to as OBD. Beginning in 1988, these regulations were phased in to include cars and light trucks marketed in the State of California. They required that the ECM monitor critical emission related components for proper operation and illuminate a malfunction indicator lamp (MIL) on the instrument panel when a malfunction was detected.

Although the OBD regulations initially apply to California emissions certified vehicles, some or all of the OBD system features are found on Federal emissions certified vehicles as well.

The OBD system uses Diagnostic Trouble Codes (DTC) and fault isolation logic charts in the Repair Manual, to assist technicians in determining the likely cause of engine control and emissions system malfunctions.

The basic objectives of this regulation are:

- To improve in-use emissions compliance by alerting the vehicle operator when a malfunction exists.
- To aid repair technicians in identifying and repairing malfunctioning circuits in the emissions control system.

OBD applies to systems that are considered most likely to cause a significant increase in exhaust emissions when a malfunction occurs. Commonly, this includes:

- All major engine sensors
- The fuel metering system
- Exhaust Gas Recirculation (EGR) function

Components and circuits are monitored for continuity, shorts, and in some cases, normal parameter range. OBD systems were normally limited to the detection of an open or short in a sensor circuit.

OBD Malfunction Indicator Lamp (MIL)

The MIL is required to serve as a visual alert to the driver of a malfunction in the system. When a malfunction occurs, the MIL remains illuminated as long as the fault is detected and goes off once normal conditions return, leaving a Diagnostic Trouble Code (DTC) stored in the ECM memory.

OBD Diagnostic Trouble Codes (DTC)

DTC(s) are generated by the on-board diagnostic system and stored in the ECM memory. They indicate the circuit in which a fault has been detected. DTC information remains stored in the ECM long-term memory regardless of whether a continuous (hard) fault or intermittent fault caused the code to set. OBD vehicles store a DTC in the ECM long-term memory until power is removed from the ECM. In most cases, the EFI fuse powers this long-term (keep alive) memory.

OBD II

- Circuit continuity and out of range values monitored
- System monitored
- Rationality checks used (logic)
- Expanded DTC(s)
- Freeze Frame Data stored with DTC
- Serial Data required
- Active Tests
- Standards established

Fig. 2-2
TL8741202

ODB II (On-Board Diagnostic System, Generation 2)

OBD II requires the ECM to monitor the effectiveness of the major emission control systems and to turn on the MIL when a malfunction is detected or when the performance of the emission system(s) has deteriorated to where the emission output will exceed the allowed emission levels.

All vehicles sold in the United States are certified through the Federal Test Procedure (FTP). It is the FTP that tests and sets maximum emission levels in accordance with government regulations. The MIL must light when a component or system will cause the vehicle's emission levels to exceed 1-1/2 times the FTP standard. This means that the OBD II system must test the performance of a system or component. For example, the ECM OBD system monitors catalytic converter efficiency. If catalytic converter efficiency is out of range, the MIL will illuminate and a DTC will set.

OBD II Standardization

OBD regulations and technical standards have been developed with the cooperation of the automotive industry and the Society of Automotive Engineers (SAE). These standards provide a common format for data, the Diagnostic Tester, diagnostic test modes, and diagnostic trouble codes regardless of the vehicle manufacturer.

A number of SAE J standards were developed to implement the OBD II system, and these standards are applicable to all vehicle and tool manufacturers. The following list is an example of the areas of standardization:

- **ISO 9141** - (International Standards Organization) Serial Data Protocol
- **J1850** - Serial Data Protocol
- **J1930** - Terms and Definitions
- **J1962** - Standard OBD II Diagnostic Connector
- **J1978** - Generic Scan Tool
- **J1979** - Diagnostic Test Mode and Basic Serial Data Stream
- **J2008** - Electronic Service Information Access and Data Format
- **J2012** - Diagnostic Codes and Messages
- **J2190** - Enhanced Diagnostic Test Modes and Serial Data Streams

What this means to you is:

- that there are common terms used by all manufacturers
- a standardized Data Link Connector (DLC) located under the driver's side of the instrument panel
- access to all OBD II data is acquired with an OBD II compatible scan tool
- common DTCs
- common diagnostic data streams

NOTE A glossary of SAE J1930 and Toyota terms and definitions can be found in the Introduction section of the Repair Manual.

OBD II Monitors

The goal of the OBD II regulation is to provide the vehicle with an on-board diagnostic system capable of continuously monitoring the efficiency of the emission control systems, and to improve diagnosis and repair efficiency when system failures occur.

On-board tests are performed by the ECM. Two types of on-board test monitoring are supported: Continuous and Non-Continuous.

Continuous monitors test components and systems many times, conditions permitting, when the engine is running. Continuous monitored systems/components are:

- Engine Misfire
- Fuel System (Trim)
- Comprehensive Components

Non-Continuous monitors test components and systems one time, conditions permitting, when the engine is running. Non-continuous monitored systems/components are:

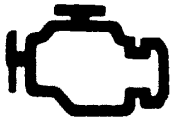
- O2 & A/F Sensor
- O2 & A/F Sensor Heater
- EGR System
- Evaporative System
- Catalyst
- Secondary Air System
- Thermostat

Beginning with the 2000 model year, manufacturers were required to phase-in diagnostic strategies to monitor the thermostat operation on vehicles so equipped. In addition, beginning with the 2002 model year, manufacturers will phase-in diagnostic strategies to monitor the PCV system on vehicles so equipped, for system integrity.

Each of these monitors is covered in detail in the following sections.

Malfunction Indicator Lamp (MIL)

Also referred to as a Check Engine Lamp.



CHECK

Fig. 2-3
TL874f203

OBD II Malfunction Indicator Lamp (MIL)

When a malfunction occurs and meets the criteria to set a DTC, the MIL illuminates and remains illuminated as long as the fault is detected. The MIL will be turned off after 3 warm-up cycles once normal conditions return. A Diagnostic Trouble Code (DTC) will be stored in the ECM memory.

OBD II Diagnostic Trouble Codes (DTC)

Unlike OBD Diagnostic Trouble Codes, OBD II codes have been standardized by SAE. They indicate the circuit or the system in which a fault has been detected.

Once the condition has been confirmed for normal operation, the DTC remains as an active code for 40 drive cycles. The code will automatically be erased after 40 drive cycles, but will remain in the ECM DTC history until cleared.

OBD	OBD II
• Current related checks (open or short)	• Circuit continuity and out of range values monitored
• Limited system monitoring (A/F & EGR)	• Systems monitored
• Minimal use of rationality checks	• Rationality checks used for component and system performance (logic)
• Limited DTC(s)	• Expanded DTC(s)
• Limited use of Serial Data	• Freeze Frame Data stored with DTC
• System and component names not standardized	• Serial Data required
• DTC(s) not standardized	• Active Tests
• MIL will turn off if problem corrects itself	• Standards established
• DTC must be cleared from memory	• MIL stays on until 3 consecutive trips have passed without the problem re-occurring
	• DTC(s) erased after 40 warm-up cycles
	• OBD II can detect malfunctions that do not effect driveability

Drive Patterns

Drive patterns are a designated set of parameters for the ECM to test components or systems. Many of these tests are based all or in part on the Los Angeles #4 (LA#4), Federal Test Procedure (FTP) driving pattern.

LA#4/FTP Drive Pattern

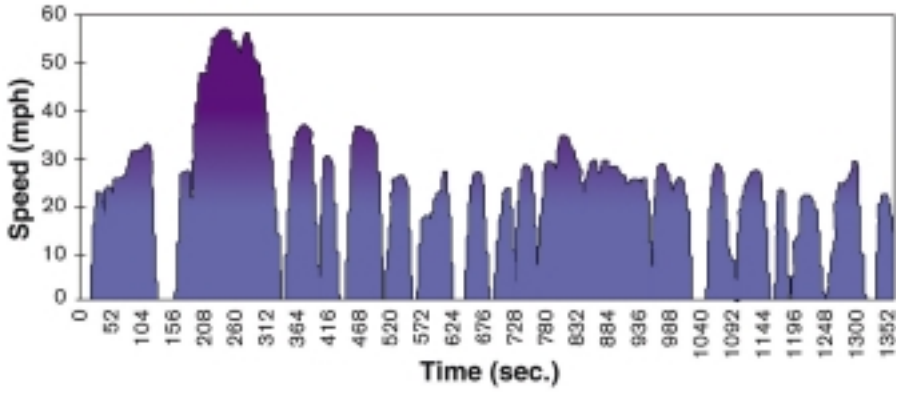


Fig. 2-4
TL874f204

LA#4 Drive Cycle

The Federal Test Procedure (FTP) drive cycle and the LA#4 drive cycle are the same. LA means Los Angeles and 4 means the 4th of the plans submitted to determine the optimum-driving pattern to measure exhaust gases. This pattern was determined while driving in Los Angeles during the morning commuting hours and includes both city and freeway driving.

FTP Drive Cycle

The FTP drive cycle, also known as LA#4, is a standardized drive pattern used for emissions certification. A system may only need a portion of the drive pattern to detect a fault or the pattern needs to be repeated for a two trip DTC fault.

The OBD II drive cycle is the basic set driving conditions for the diagnostic monitors to run. This does not mean that all monitors can be completed with this drive pattern because a warm-up cycle or other additional parameters may be required. Also a test may be interrupted by a fault in another related system.

If a fault is present, a DTC should appear if the driving pattern is completed along with any other operating condition noted in the Repair Manual.

OBD II Trip

The OBD II trip, or "trip", contrasted with the LA#4/FTP drive cycle, consists of an engine start following an engine off period, with enough vehicle travel to allow the OBD II monitoring sequences to complete their tests. The vehicle must be driven under a variety of operation conditions for all tests to be performed.

Trip

A trip is defined as an engine-operation drive cycle that contains all of the necessary conditions for a particular test to be performed. Some DTC(s) may require a warm-up cycle, while others require just a key off cycle.

Completing the trip correctly is necessary to verify a symptom or confirm a successful repair.

Warm-Up Cycle

OBD II standards define a warm-up cycle as a period of vehicle operation, after the engine was turned on, in which coolant temperature rises by at least 22°C (40°F) and reaches at least 88°C (160°F). The ECM determines a cold start by comparing the engine coolant temperature (ECT) and the intake air temperature (IAT).

Confirmation Driving Patterns

The Repair Manual lists special confirmation driving patterns specific to a particular DTC. The confirmation procedure listed may not actually require the vehicle to be driven. The confirmation procedure is designed to verify the operation of a component or system. The conditions listed in the Repair Manual must be strictly followed or the detection of the malfunction will not be possible.

NOTE The confirmation drive pattern may require the use of the Diagnostic Tester. In addition, the instructions may call for switching from normal to check mode.

NOTE The conditions outlined in this section are general and intended to serve as a guide only.

Malfunction Indicator Lamp and Diagnostic Trouble Codes

OBD II regulations require the ECM to light the Malfunction Indicator Lamp (MIL) when the ECM detects a malfunction in the emission control system/components or in the powertrain control components that affect vehicle emissions.

In addition to the MIL lighting when a malfunction is detected, the applicable Diagnostic Trouble Code (DTC) prescribed by SAE J2012 is recorded in the ECM Memory.

MIL ON

There are two basic reasons why the MIL will light and remain on: a failure of a component monitor, or a failure of a system monitor. When the MIL is turned on, a DTC is stored, as well as Freeze Frame data.

NOTE There is the possibility that two Freeze Frame data displays are stored from two DTCs. Refer to the section on Freeze Frame data in this handbook for additional details.

MIL ON One Trip

There are some DTCs that will set in one trip. A one trip DTC will store a code that can be observed in the DTC screen, set a Freeze Frame, and light the MIL.

MIL ON One Trip

In this illustration, the fault occurred during the first trip. The MIL came on when the basic parameters for the diagnostic test were met and the test completed, confirming the fault. Also the DTC and Freeze Frame were recorded in memory when the MIL came on.

Fig. 2-5
TL874f205

MIL ON Two Trip

When a two trip emissions-related fault is detected for the first time, a DTC related to that fault is stored as a pending code. This pending code can often be seen in the Mode 7 screen - Continuous Tests (if the ignition key is not turned off).

If the fault occurs again on the second drive cycle, then the DTC is stored as a current code (can be seen in the DTC screen), and the ECM will turn on the MIL.

The pending fault will be erased if the monitoring sequence does not detect a fault under the same conditions.

MIL ON Two Trip

In this illustration, the fault occurred during the first trip. The MIL came on during the second trip after the basic parameters for the diagnostic test were met and the test completed, confirming the fault. The DTC and Freeze Frame were recorded in memory when the MIL came on during the second trip.

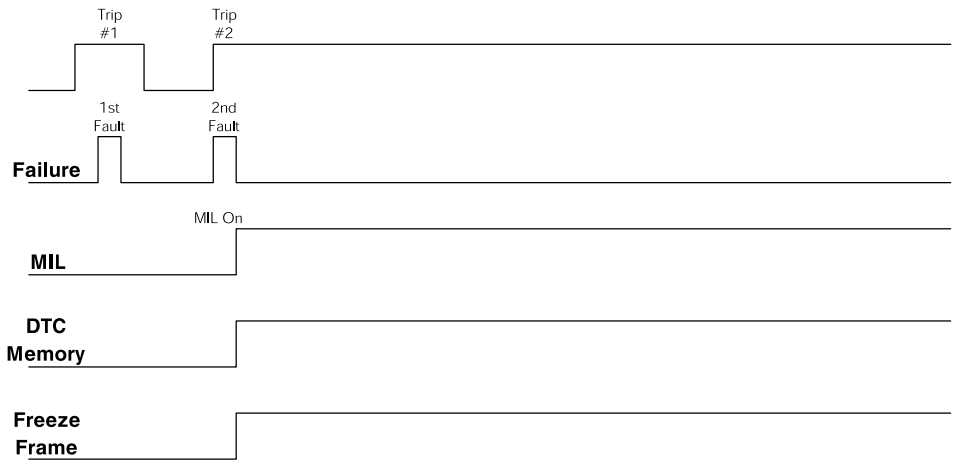


Fig. 2-6
TL874f206

MIL Blinking

The MIL will blink when a misfire occurs that will raise the temperature enough to damage the catalytic converter. The blinking may be intermittent, because of changes in engine load and the severity of engine misfire.

A misfire that will allow emissions to exceed regulations, but not damage the catalyst, will light the MIL but not blink the light. The MIL will light on the second trip if the misfire occurs under similar conditions. See Misfire Diagnosis for more details.

MIL Blinking

When a misfire occurs that is severe enough to damage the Catalytic Converter the MIL will blink during the first trip. If the condition reoccurs during the second trip, the MIL again blinks, the DTC and Freeze Frame are recorded in memory. The MIL will be on solid once the DTC is recorded if the misfire is no longer severe enough to damage the catalyst.

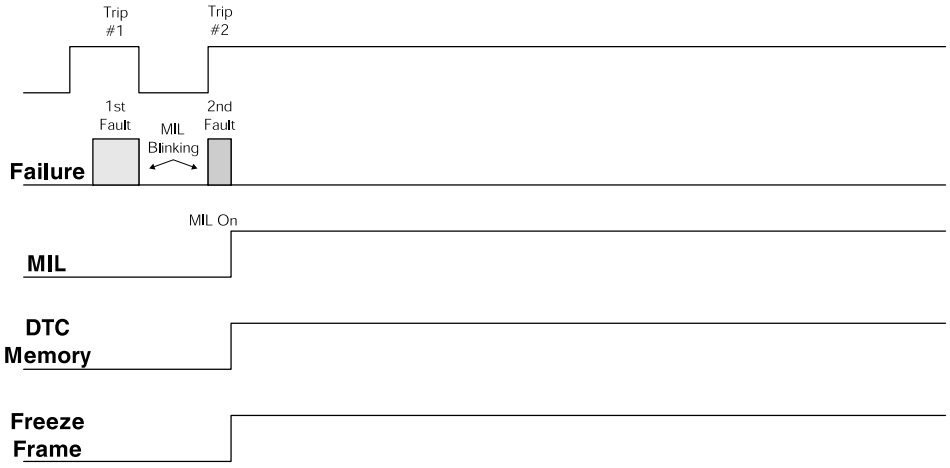


Fig. 2-7
TL874f207

MIL OFF, DTC and Freeze Frame Erased

When the ECM confirms that the fault is no longer present, the MIL is turned off after three trips where the basic parameters for the diagnostic test are met and the test completed without the fault being detected. After 40 warm-up cycles without the fault being detected, the DTC and Freeze Frame are erased from memory as current; however, the DTC and Freeze Frame will remain in DTC history as a history code and Freeze Frame until cleared.

NOTE

A DTC found in history, but not related to a current condition is most likely the result of an intermittent condition or previous repair since the conditions that set the code have not recurred for at least 40 cycles.

MIL Off, DTC and Freeze Frame Erased

In this illustration, the fault did not recur after the MIL came on, therefore, the MIL was turned off after three trips without a fault being detected. After 40 successful trips without the fault being detected, the DTC and Freeze Frame were erased from memory. However, the DTC will remain in history until cleared.

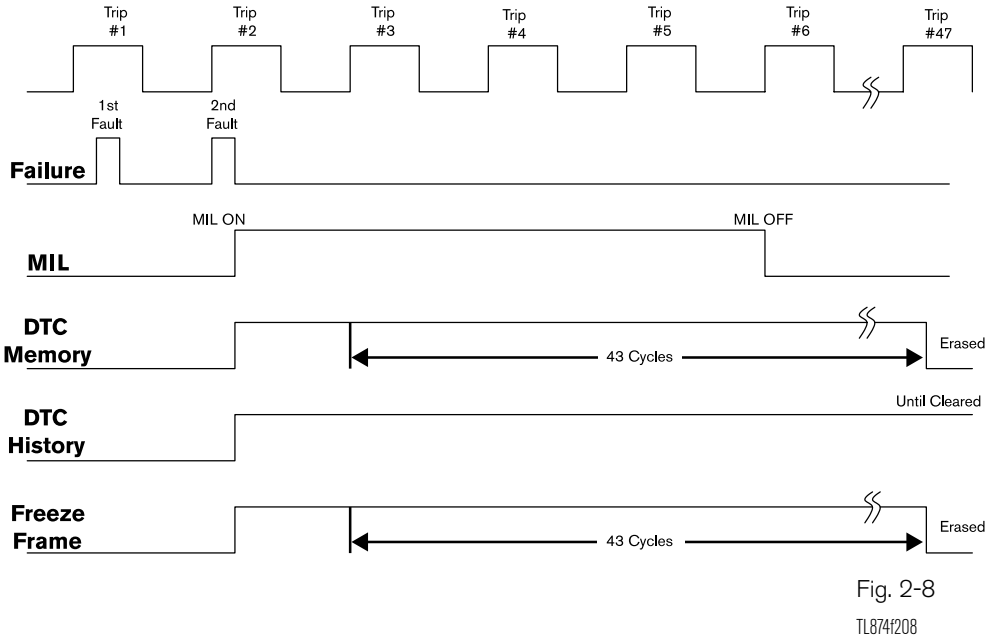


Fig. 2-8
TL874f208

Extinguishing the MIL

Once lit, the MIL will remain on until the vehicle has completed three consecutive good trips (three trips in which the effected diagnostic monitor runs and passes).

Should the MIL blink due to a misfire, the MIL will go off if the misfire is no longer detected. A misfire DTC will be stored if the misfire meets the criteria for storing in the ECM memory.

If the DTC has not been cleared since the MIL was turned off, the erased DTC will be stored in DTC history until the memory is cleared.

Summary of MIL and DTC Operation

Misfire detected severe enough to damage catalytic converter:

- **MIL Blinking** - One trip fault
- **MIL Illumination** - One and two trip faults
- **MIL Extinguished** - Three consecutive trips, fault not detected
- **DTC Memory Erasure** - 40 Warm-up cycles, fault not detected or when cleared with DT
- **DTC History** - DTC is held in history until cleared with DT
- **Freeze Frame Erasure** - 40 Warm-up cycles, fault not detected or when cleared with DT

OBD II Definition

Each DTC is assigned a number to indicate the circuit, component, or system area that was determined to be at fault. The numbers are organized such that different codes related to a particular sensor or system are grouped together.

OBD II Diagnostic Trouble Code Chart

First Digit	Second Digit	Third Digit	Fourth Digit	Fifth Digit
	Prefix Letter of DTC Indicates Component Group Area	SAE or Controlled	Powertrain DTC Subgroup	Area or Component involved
	P = Powertrain	0 = SAE	0 = Total System	
	B = Body	1 = Manufacturer	1 = Fuel and Air Metering	
	C = Chassis		2 = Fuel and Air Metering	
	U = Network Communication		3 = Ignition System or Misfire	
			4 = Auxiliary Emission Controls	
			5 = Speed, Idle, & Auxiliary Inputs	
			6 = ECM and Auxiliary Inputs	
			7 = Transmission	
Example			8 = Transmission	
Fuel Trim Malfunction	P	0	1	71

Manufacturer Enhanced OBD II

OBD II regulations allow the manufacturer to add additional information to the data stream and DTCs. A "1" in the second digit of the DTC code indicates it is a manufacturer specific DTC. Toyota has an enhanced data stream, which consists of 60 or more additional data words. As new systems are created, additional data is added to the data stream.

OBD II Scan Tool Features

When the decision was made to create a scan tool that could access all manufacturers vehicles, it also meant there had to be a standardized way of communicating information to the technician. Common Diagnostic Trouble Codes (DTC) is one aspect. The manufacturer of the vehicle or scan tool can add more data streams, report modes, and diagnostic tests.

The following is a list of modes that every OBD II compatible scan tool and vehicle must support.

CARB MODES	GENERIC TITLE	TOYOTA TITLE
Mode 1	Current Powertrain Diagnostic Data	DATA LIST and READINESS TESTS
Mode 2	Powertrain Freeze Frame Data	FREEZE DATA
Mode 3	Emission Related Powertrain DTCs	DTCs
Mode 4	Clear/Reset Emission Related Diagnostic Information	CLEAR DIAG INFO
Mode 5	O2 sensor Monitoring Test Results	O2S TEST RESULTS
Mode 6	On-Board Monitoring Test Results for Non-Continuously Monitoring Systems	NON-CONTINUOUS
Mode 7	On-Board Monitoring Test Results for Continuously Monitored Systems	CONTINUOUS
Mode 8	Request Control of On-Board System Test or Component	EVAP LEAK TEST
Mode 9	Request Vehicle Information	INFORMATION MENU

Mode 1: Current Powertrain Diagnostic Data

This mode provides access to current emission related data values such as inputs, outputs, and system status. All input values that are displayed are current values. No substitute values are permitted if there is a problem with the input sensor/circuit. This information is referred to as serial data and found under Data List.

Data List

```
CURRENT DATA

ENGINE SPD..... 2260RPM
COOLANT TEMP..... 190°F
VEHICLE SPD..... 60MPH
IGN ADVANCE..... 38.0°
CALC LOAD..... 37.2%
MAF..... 1.21b/min
THROTTLE POS..... 10.1%
INTAKE AIR..... 93°F
FUEL SYS #1..... OLDRIVE
FUEL SYS #2..... OLDRIVE
SHORT FT #1..... 0.0%
LONG FT #1..... -1.5%
SHORT FT #2..... 0.0%
LONG FT #2..... -1.5%
O2S B1 S1..... 0.705V
O2FT B1 S1..... 0.0%
O2S B1 S2..... 0.120V
O2FT B1 S2..... UNUSED
O2S B2 S1..... 0.660V
O2FT B2 S1..... 0.0%
MIL..... ON
# CODES..... 1
MISFIRE MON..... AVAIL
FUEL SYS MON..... AVAIL
COMP MON..... AVAIL
CAT EVAL..... COMPL
HTD CAT EVAL..... N/A
EVAP EVAL..... INCMPL
2nd AIR EVAL..... N/A
A/C EVAL..... N/A
O2S EVAL..... INCMPL
O2S HTR EVAL..... INCMPL
EGR EVAL..... COMPL
OBD CERT..... OBD II
```

Fig. 2-9
TL874f209

NOTE **The READINESS TEST screen and MONITOR STATUS screen contain identical information. You can use either screen to confirm monitor operation.**

Readiness Test Status

The example to the right shows which monitors have completed and which monitors are available or not available (do not apply to this vehicle). The Non-Continuous monitors have all completed. The Continuous monitors are available and run continuously.

INCMPL stands for incomplete. Incomplete can mean the monitor did not complete, judgment is withheld pending further testing, the monitor did not operate, or the monitor operated and recorded a failure. Please see Modes 6 and 7 for additional details.

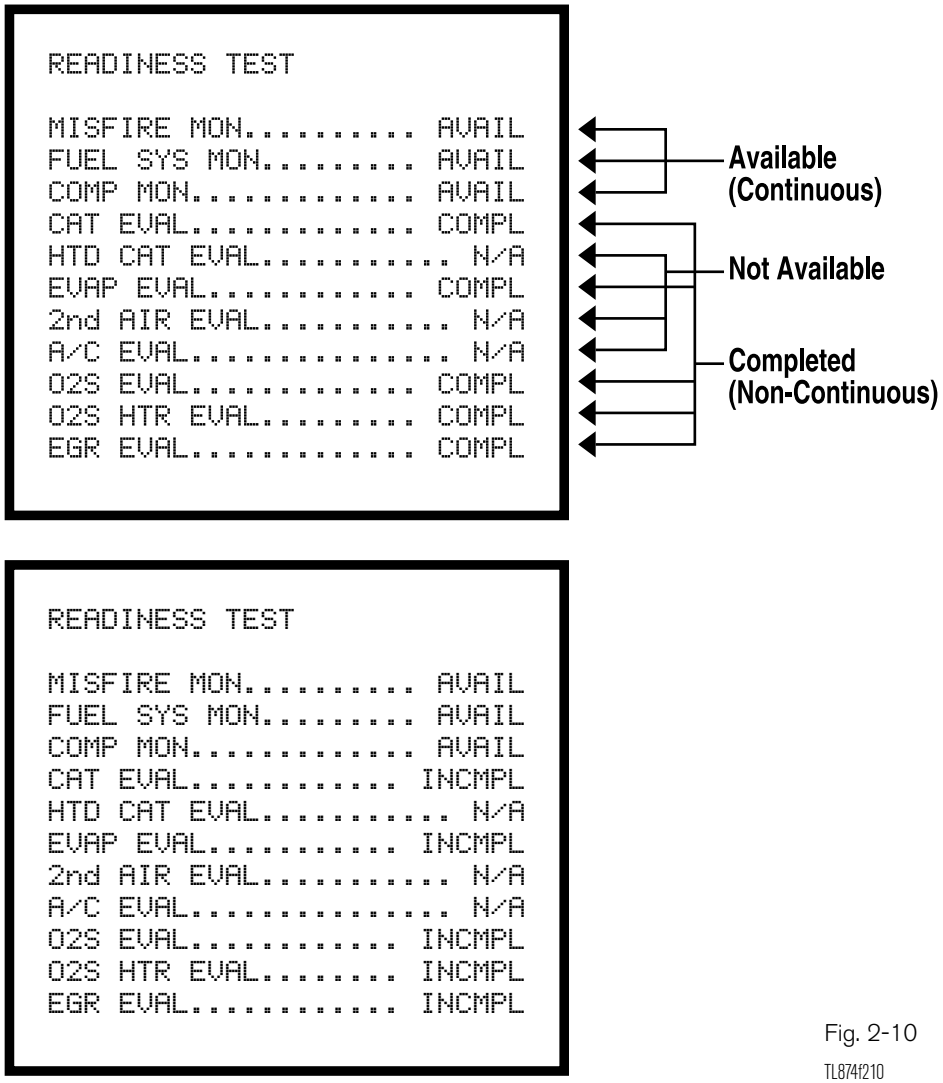


Fig. 2-10
TL874f210

Mode 2: Powertrain Freeze Frame Data

This mode displays emission related values that are stored when the ECM has determined there has been an emission related failure. The manufacturer can add more values beyond the emission related values. All values are actual readings, none are substituted values.

Manufacturers are free to add additional Freeze Frames.

If a fault is detected and recorded, that information is stored as a "Freeze Frame." The ECM uses this data for identification and comparison of similar operating conditions when they recur. The data is also available to the diagnostic technician for use in identifying what conditions were present when the DTC was set. This information can only be accessed with the Diagnostic Tester.

CARB Freeze Frame

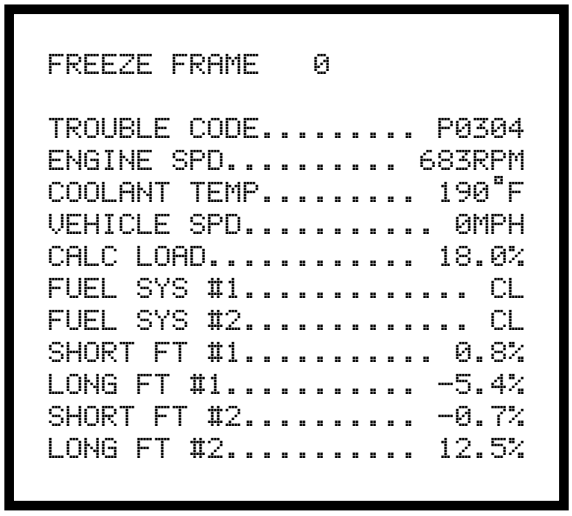


Fig. 2-11
TL874f211

Under CARB, only one Freeze Frame is stored with the required data. In Enhanced OBD II, two Freeze Frames are stored with additional data. The CARB Freeze Frame is listed under the CARB menu and accessed from there.

Freeze Frame Data

Freeze Frame information typically includes:

- DTC involved
- Engine RPM
- Engine load
- Fuel trim (short and long term)
- Engine Coolant Temperature
- Calculated load
- Operating mode (open or closed loop)
- Vehicle speed

Enhanced Freeze Frame Priority

Two Freeze Frames can be stored in the Enhanced OBD II mode in the ECM. The first is reserved for information related to misfire and fuel control, which have priority over other DTC(s). The second, if not occupied by one of the priority DTC(s), will store information for the first non-priority DTC that occurs. The Freeze Frame information updates if the condition recurs.

Enhanced Freeze Frame Priority

The first frame is reserved for misfire and fuel control DTC data only. The second frame will store the second misfire or fuel control DTC data first. If the second frame is not used for a priority DTC, the ECM can store data related to other DTC(s).

First Freeze Frame

Second Freeze Frame

Fig. 2-12
TL874f212

Accessing Enhanced Freeze Frame Data

When using the Diagnostic Tester, an * (asterisk) next to the Trouble Code ID indicates there is Freeze Frame data associated with that DTC. If Freeze Frame data is available for the highlighted DTC, press Enter to display the data.

Accessing Enhanced Freeze Frame Data

The Diagnostic Tester screens show stored DTC(s), both priority and non-priority and the Freeze Frame Data stored for each of these DTC(s). The Freeze Frame Data is displayed in the same format for all DTC(s).

Trouble Codes

```
  ECU: $10 (Engine)
  Number of DTCs: 3

* P0304
  Cylinder 4 Misfire
  Detected

  P0100
  Mass or Volume Air
  Flow Circuit Malfunction

* P0110
  Intake Air Temperature
  Circuit Malfunction
```

Priority Freeze Frame

```
TROUBLE CODE..... P0304
CALC LOAD..... 18%
ENGINE SPD..... 683RPM
COOLANT TEMP..... 190.4°F
INTAKE TEMP..... 125.6°F
CTP SW..... ON
VEHICLE SPD..... 0MPH
SHORT FT #1..... 0.7%
LONG FT #1..... -5.5%
SHORT FT #2..... -0.9%
LONG FT #2..... 12.4%
FUEL SYS #1..... CL
FUEL SYS #2..... CL
FC IDL..... OFF
STARTER SIG..... OFF
A/C SIG..... OFF
PNP SW [NSW]..... ON
ELECT LOAD SIG..... OFF
STOP LIGHT SW..... OFF
ENG RUN TIME..... 80
```

Non-Priority Freeze Frame

```
TROUBLE CODE..... P0110
CALC LOAD..... 0%
ENGINE SPD..... 662RPM
COOLANT TEMP..... 192.2°F
INTAKE TEMP..... -40.0°F
CTP SW..... ON
VEHICLE SPD..... 0MPH
SHORT FT #1..... 1.5%
LONG FT #1..... -5.5%
SHORT FT #2..... 1.5%
LONG FT #2..... 12.4%
FUEL SYS #1..... CL
FUEL SYS #2..... CL
FC IDL..... OFF
STARTER SIG..... OFF
A/C SIG..... ON
PNP SW [NSW]..... ON
ELECT LOAD SIG..... OFF
STOP LIGHT SW..... OFF
ENG RUN TIME..... 0
```

Fig. 2-13
TL874f213

Using Freeze Frame Data for Diagnosis The Freeze Frame data screen provides information of the conditions that were present at the time the DTC was recorded in memory. By recreating the vehicle speed, engine RPM, and engine load, as well as other conditions noted, the technician can verify the customer's concern.

Mode 3: Emission Related Powertrain DTCs

When in this mode, the Diagnostic Tester retrieves all stored emission related DTCs in the ECM. See MIL ON section for additional details.

Mode 4: Clear/Reset Emission Related Diagnostic Information

When this mode is activated by the Diagnostic Tester, all DTCs, Freeze Frame data, O2 sensor monitoring test results, status of monitoring system test (Readiness Tests) results, and on-board test results are cleared and reset. The Diagnostic Tester and ECM must be able to respond to this request with ignition key on and engine off.

OBD II DTC(s) are automatically erased after 40 warm-up cycles if the failure is not detected again. These 40 cycles begin only after the ECM turns off the MIL. The Freeze Frame data is cleared at the same time. A technician using the Diagnostic Tester can also clear the DTC(s) and freeze frame data, however, this will clear DTC history also.

O2 Sensor Monitoring Screens

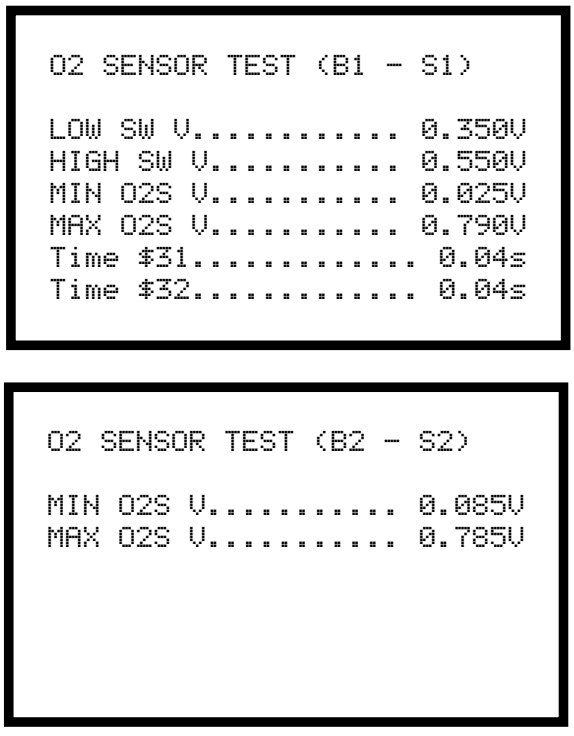


Fig. 2-14
TL874f214

Mode 5: O2 Sensor Monitoring Test Results

This mode displays the test results of the O2 sensor test monitor. This screen's data can be used as a report on the condition of the O2 sensor(s), and is found under O2S TEST RESULTS.

NOTE

These values are stored values, not current values that are found in Mode 1 (DATA LIST). These values are reported only if the O2 sensor monitor has run. This information is lost if the ignition key is turned off.

Not all test values are applicable to all manufacturers. The A/F sensor test values are not applicable and are not displayed in Mode 5. Some vehicles use Non-Continuous Test Results mode to report results. For more information see the section on O2 and A/F Sensor Diagnosis.

Mode 6: On-Board Monitoring Test Results for Non-Continuous Monitoring Systems

Two different screens showing Pass and Fail. Some vehicles will show TID in place of Time.

- (TID)Time$01 = Catalyst Deterioration
- (TID)Time$02 = Evaporative System Deterioration
- (TID)Time$03 = Not Supported
- (TID)Time$04 = O2 Sensor Heater
- (TID)Time$05 = EGR
- (TID)Time$06 = A/F Sensor
- (TID)Time$07 = A/F Sensor Heater
- (TID)Time$08 = Thermostat Monitor

```
NON-CONTINUOUS TESTS

Time$01 CID$01........ Pass
Time$02 CID$01........ Pass
Time$02 CID$02........ Pass
Time$02 CID$03........ Pass
Time$02 CID$04........ Pass
Time$04 CID$00........ Pass
Time$04 CID$02........ Pass
Time$05 CID$01........ Pass
Time$06 CID$01........ Pass
Time$07 CID$01........ Pass
```

```
NON-CONTINUOUS TESTS

Time$01 CID$01........ Pass
Time$02 CID$01........ Fail
Time$02 CID$02........ Fail
Time$02 CID$03........ Fail
Time$02 CID$04........ Fail
Time$04 CID$00........ Pass
Time$04 CID$02........ Pass
Time$05 CID$01........ Pass
Time$06 CID$01........ Pass
Time$07 CID$01........ Pass
```

Fig. 2-15
TL874f215

Mode 6: On-Board Monitoring Test Results for Non-Continuous Monitoring Systems

This mode reports on the Non-Continuous monitors:

- Catalyst
- Evaporative System
- Secondary Air System
- O2 & A/F Sensor
- O2 & A/F Sensor Heater
- EGR System
- Thermostat

You can use this mode to identify potential problems in the Non-Continuous monitored systems.

The ECM compares the Non-Continuous monitor test data to the test limits and reports to the Diagnostic Tester a Pass or Fail indication for each monitored system/component. This mode will report results in one trip if the monitor runs and completes its testing. The results can be found in Non-Continuous Tests.

Mode 7: On-Board Monitoring Test Results for Continuous Monitoring Systems

This mode reports test results for emission related powertrain components that are Continuously and Non-Continuously monitored in one trip under normal driving conditions. It will report a failure as a DTC. This allows you to test the vehicle for problems and (after clearing DTCs) to check on a repair in one trip. This mode is found in Continuous Tests.

NOTE

The DTCs that are initially reported in Continuous Tests and Pending Codes are pending DTCs. If conditions persist, DTCs will be stored in the normal areas.

For a DTC to be reported, the monitor has to be operating, though the monitor may not go to completion. This is the first place a DTC will show up. A two trip DTC reported in this mode on the first trip may not be accurate and may change during monitoring. Another trip is needed to confirm that the reported DTC is valid. If a DTC is reported in this mode there is good reason to suspect that there is a problem with the vehicle and further checks are necessary before returning to the owner.

Please see the section on Continuous Monitors for more information.

Mode 7 Continuous Tests DTC Screen and Pending CodesScreen

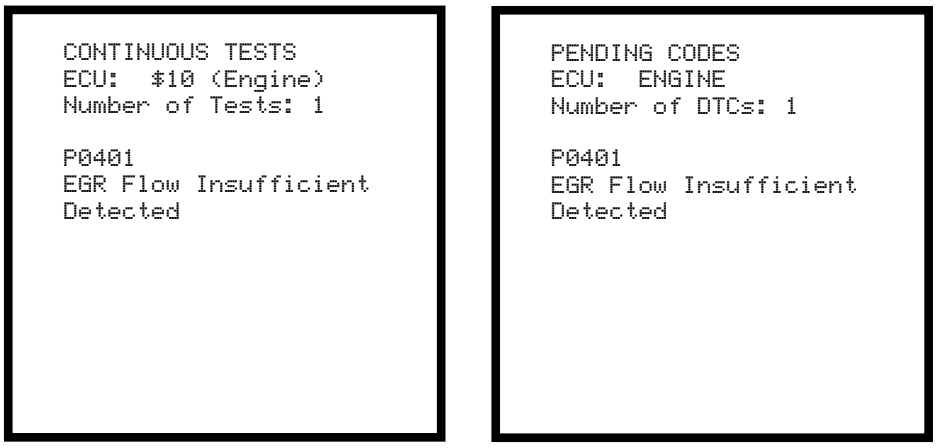


Fig. 2-16
TL874f216

Mode 8: Request Control of On-Board System Test or Component

This mode enables the Diagnostic Tester to control the ECM in order to test the system and related components. Currently, the EVAP leak test procedure is under this mode. When the EVAP leak test is enabled, it sets the conditions for leak testing but does not conduct a leak test.

Mode 8 EVAP Leak Test

Fig. 2-17
TL8741217

Mode 9: Request Vehicle Information

This mode reports the following if the ECM supports this function:

- Vehicle Identification Number
- Calibration Identification
- Calibration Verification

This mode is found in Information Menu.

Mode 9 Vehicle Information

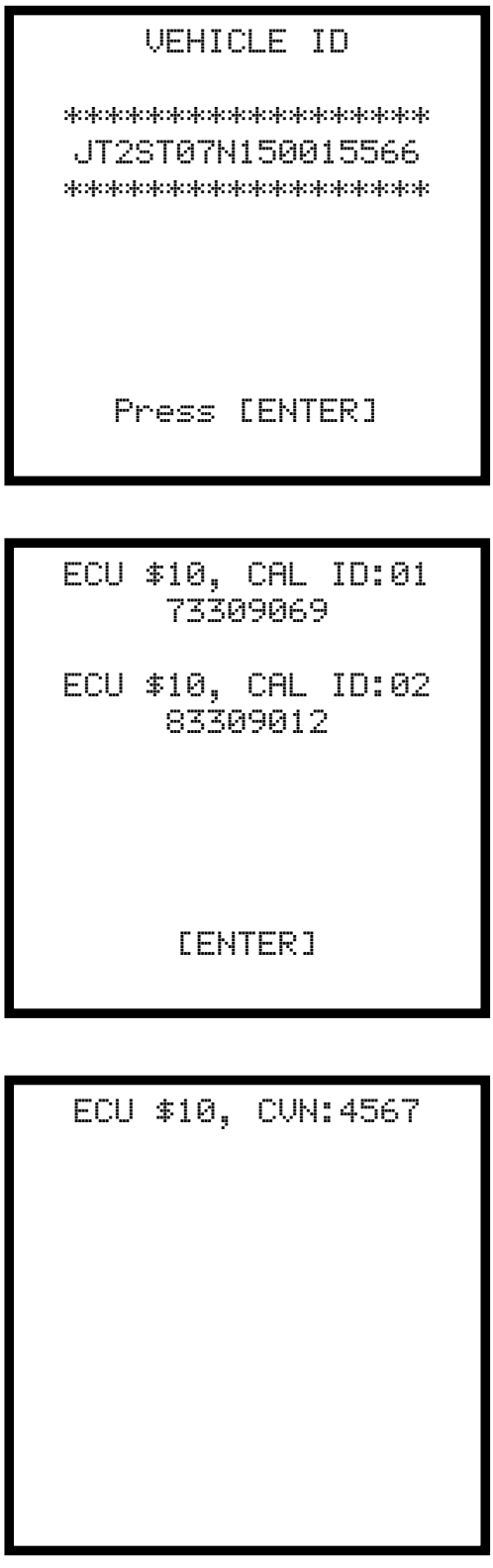


Fig. 2-18
TL874f218

How to Proceed with Troubleshooting OBD II Systems

The following steps provide a general outline with explanations for troubleshooting OBD II systems. There are slight variations in different years and with different models. Please review the procedure, General OBD II Scan Tool or Diagnostic (Hand-held) Tester Procedure in Section 1 before reading this section.

Troubleshooting OBD II systems involves a series of steps as listed in the figure 2-19 on the following page. The order will vary depending on symptoms.

OBD II Engine Troubleshooting Procedure

Each numbered step is explained in the following text.

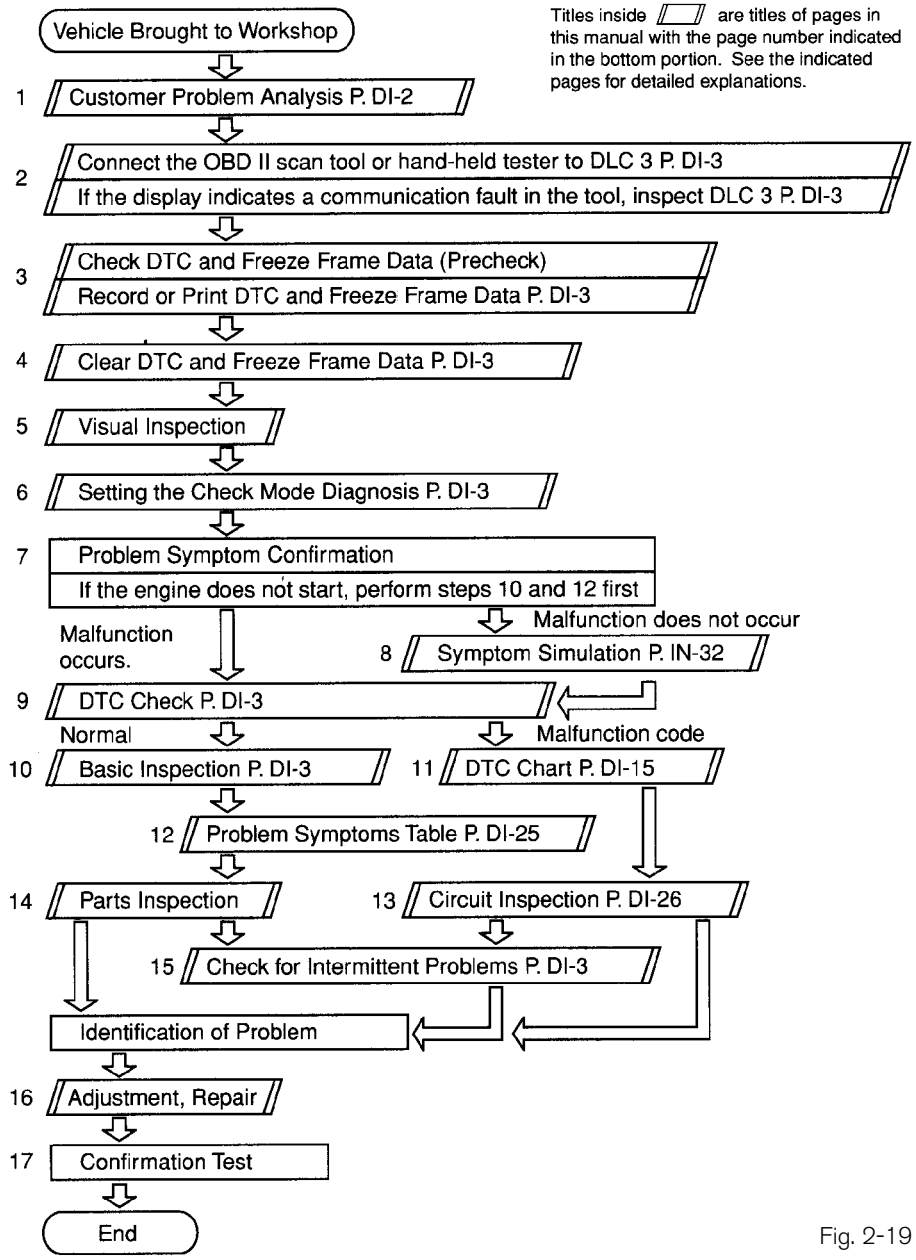


Fig. 2-19
TL874f219

Step 1: Customer Problem Analysis

Always begin with getting as much information about the conditions when the problems occur. Service managers and assistant service managers need to work with you to prevent wasted time and resources. The sophisticated systems you are working with require accurate, timely information. The Customer Problem Analysis Check Sheet needs to be familiar to all those who communicate with the customer.

Customer Problem Analysis Check

ENGINE CONTROL SYSTEM Check Sheet Inspector's Name

Customer's Name		Model and Model Year	
Driver's Name		Frame No.	
Date Vehicle Brought in		Engine Model	
License No.		Odometer Reading	km miles

Problem Symptoms	☐ Engine does not Start	☐ Engine does not crank ☐ No initial combustion ☐ No complete combustion
	☐ Difficult to Start	☐ Engine cranks slowly ☐ Other _____
	☐ Poor Idling	☐ Incorrect first idle ☐ Idling rpm is abnormal ☐ High (rpm) ☐ Low (rpm) ☐ Rough idling ☐ Other _____
	☐ Poor Driveability	☐ Hesitation ☐ Back fire ☐ Muffler explosion (after-fire) ☐ Surging ☐ Knocking ☐ Other _____
	☐ Engine Stall	☐ Soon after starting ☐ After accelerator pedal depressed ☐ After accelerator pedal released ☐ During A/C operation ☐ Shifting from N to D ☐ Other _____
	☐ Others	

Dates Problem Occurred		
Problem Frequency		☐ Constant ☐ Sometimes (times per day/month) ☐ Once only ☐ Other _____
Condition When Problem Occurs	Weather	☐ Fine ☐ Cloudy ☐ Rainy ☐ Snowy ☐ Various/Other _____
	Outdoor Temperature	☐ Hot ☐ Warm ☐ Cool ☐ Cold (approx. ____ °F/____ °C)
	Place	☐ Highway ☐ Suburbs ☐ Inner city ☐ Uphill ☐ Downhill ☐ Rough road ☐ Other _____
	Engine Temp.	☐ Cold ☐ Warming up ☐ After warming up ☐ Any temp. ☐ Other _____
	Engine Operation	☐ Starting ☐ Just after starting (min.) ☐ Idling ☐ Racing ☐ Driving ☐ Constant speed ☐ Acceleration ☐ Deceleration ☐ A/C switch ON/OFF ☐ Other _____

Condition of MIL		☐ Remains on	☐ Sometimes lights up ☐ Does not light up
DTC Inspection	Normal Mode (Precheck)	☐ Normal	☐ Malfunction code(s) (code) ☐ Freezed frame data ( )
	Check Mode	☐ Normal	☐ Malfunction code(s) (code) ☐ Freezed frame data ( )

Fig. 2-20
TL874f220

Step 2: Connect Diagnostic Tester

When troubleshooting OBD II vehicles, you must use an OBD II scan tool complying with SAE J1978 or Diagnostic Tester, and interpret various data output from the vehicle's ECM.

OBD II regulations require that the vehicle's on-board computer turns on the Malfunction Indicator Lamp (MIL) on the instrument panel when the computer detects a malfunction in the emission control system/ components, in the powertrain control components that affect vehicle emissions, or a malfunction in the computer. In addition to the MIL lighting when a malfunction is detected, the applicable Diagnostic Trouble Codes (DTC(s)) prescribed by SAE J2012 are recorded in the ECM memory (See section on OBD Systems Overview).

If the malfunction does not occur in three trips the MIL goes off automatically but the DTC(s) remain recorded in the ECM memory.

Step 3: Check DTC(s) and Freeze Frame Data

To check the DTC(s), connect the Diagnostic Tester to the Data Link Connector 3 (DLC3) on the vehicle. The OBD II scan tool or Diagnostic Tester also enables you to erase the DTC(s) and check Freeze Frame data and various forms of engine data (For operating instructions, see the OBD II scan tool's instruction book). DTC(s) include SAE controlled codes and manufacturer controlled codes. SAE controlled codes must be set as prescribed by the SAE, while manufacturer controlled codes can be set freely by the manufacturer within the prescribed limits (See DTC chart in the Repair Manual).

The ECM diagnostic system operates in normal mode during normal vehicle use. It also has a check mode for technicians to simulate malfunction symptoms and troubleshooting. Most DTC(s) use two trip detection logic (see below) to prevent erroneous detection and ensure thorough malfunction detection. By switching the ECM to check mode when troubleshooting, the technician can cause the MIL to light up for a malfunction that is only detected once or momentarily (using the Diagnostic Tester and certain DTCs only) (See step 2).

Two trip detection logic:

- When a malfunction is first detected, the malfunction is temporarily stored in the ECM memory (first trip).

- If the same malfunction is detected again during the second drive test, this second detection causes the MIL to light up (second trip) (However, the ignition switch must be turned OFF between the first trip and second trip).

- Freeze Frame data records the engine condition when a misfire (DTC(s) P0300 - P0308) or fuel trim malfunction (DTCs P0171, P0172, P0174 and P0175) or other malfunction (first malfunction only), is detected. The Freeze Frame data records the engine conditions (fuel system, calculated load, engine coolant temperature, fuel trim, engine speed, vehicle speed, etc.) when a malfunction is detected.

When troubleshooting, it is useful for determining whether the vehicle was running or stopped, the engine was warmed up or not, the A/F ratio was lean or rich, etc., at the time of the malfunction.

Check Service History and Service Publications

At this point, checking TSBs or other service publications may have the necessary repair information.

Checking the service history can provide clues about cause of the problem. The condition may be related to a recent repair.

NOTE Checking TSBs and service history is not specifically outlined in the Repair Manual diagnostic procedure.

Priorities for Troubleshooting

If troubleshooting priorities for multiple DTC(s) are given in the applicable DTC chart, those should be followed.

If no instructions are given, follow the order given in the beginning of the DI section. Below is a typical procedure to troubleshoot DTC(s) according to the following priorities:

(1) DTC(s) other than fuel trim malfunction (DTC(s) P0171, P0172, P0174 and P0175) and misfire (DTC(s) P0300 - P0308).

(2) Fuel trim malfunction (DTC(s) P0171, P0172, P0174 and P0175).

(3) Misfire (DTC(s) P0300 - P0308).

No Communication

If no communication, you will need to check the OBD II diagnostic circuit. An explanation of this procedure is in the section on ECM Diagnostics.

Step 4: Clear DTC and Freeze Frame Data

This procedure is used to verify if the fault is currently present. Doing this step will save you time.

INSPECT DIAGNOSIS (Normal Mode)

(a) Check the MIL.

(1) The MIL comes on when the ignition switch is turned ON and the engine is not running.

NOTE If the MIL does not light up, troubleshoot the combination meter.

(2) When the engine is started, the MIL should go off. If the lamp remains on, the diagnosis system has detected a malfunction or abnormality in the system.

(b) Check the DTC.

NOTE If there is no DTC in the normal mode, check to see if there are any DTC(s) (first trip DTC) by going to the Continuous Test Results function (Mode 7 for SAE J1979) or Pending Codes on the Diagnostic Tester. For some DTC(s) to set, the vehicle must be driven in a specified driving pattern. See Readiness Test Confirmation Strategy.

(1) Prepare the Diagnostic Tester.

(2) Connect the Diagnostic Tester to DLC3 at the lower left of the instrument panel.

(3) Turn the ignition switch ON and switch the Diagnostic Tester ON.

(4) Use the Diagnostic Tester to check the DTC(s) and Freeze Frame data. Print or write the information for future reference.

(5) See the DI section in the Repair Manual to confirm the details of the DTC(s).

NOTE When the diagnosis system (Diagnostic Tester only) is switched from the normal mode to the check mode, it erases all DTC(s) and Freeze Frame data recorded in the normal mode. So before switching modes, always check the DTC(s) and Freeze Frame data, and print or write them down.

NOTE When simulating symptoms with a generic OBD II scan tool, check the DTC(s) and use the normal mode. For codes on the DTC chart subject to "two trip detection logic", perform either of the following actions.

Turn the ignition switch OFF after the symptom is simulated the first time. Then repeat the simulation process again. When the problem has been simulated twice, the MIL lights up and the DTC(s) are recorded in the ECM.

Check the first trip DTC using Mode 7 (Continuous Test Results) or Pending Codes. See Readiness Test Confirmation Strategy.

(c) Clear the DTC.

The DTC(s) and Freeze Frame data will be erased by either action.

(1) Operate the Diagnostic Tester to erase the codes (See the Diagnostic Toolset Operator's Manual for instructions).

(2) Disconnecting the battery terminals or EFI and ETCS fuses.

NOTE If the Diagnostic Tester switches the ECM from the normal mode to the check mode or vice-versa, or if the ignition switch is turned from ON to ACC or OFF during the check mode, the DTC(s) and Freeze Frame data will be erased.

Fail-Safe Chart

For many DTCs, the ECM enters fail-safe mode. A chart in the DI section lists the action the ECM takes when a DTC is present.

Fail-Safe Chart

The Fail-Safe Chart is located in the DI section. If any of the listed DTCs are present, the ECM enters Fail-Safe mode. In most cases, this means the ECM substitutes a value so that the engine will continue to run.

DTC No.	Fail-Safe Operation	Fail-Safe Deactivation Conditions
P0100	Ignition timing fixed at 5° BTDC	Returned to normal condition
P0110	Intake air temperature is fixed at 20°C (68°F)	Returned to normal condition
P0115	Engine coolant temperature is fixed at 80°C (176°F)	Returned to normal condition
P0135 P0141 P0155 P0161	The heater circuit in which an abnormality is detected is turned off	Ignition switch OFF
P0325 P0330	Max. timing retardation	Ignition switch OFF
P1300	Fuel cut	Returned to normal condition

Fig. 2-21
TL874f221

Step 5: Visual Inspection

This is a quick check of the basics such as:

- Is there gasoline in the tank?
- All hoses and wires connected and routed correctly?
- Does the vehicle start? If not, go to steps 10 and 12 first.

NOTE Do not wiggle or shake wires at this time. You will want to see if the fault is present. Shaking wires could temporarily fix the problem.

Step 6: Check Mode

Check Mode is an operation to speed up diagnosis. Compared to Normal Mode, Check Mode has an increased sensitivity to detect malfunctions. Furthermore, the same diagnostic items that are detected in Normal Mode can also be detected in Check Mode.

Check the DTC in the Repair Manual to see if Check Mode is used to verify the condition. Check Mode will not work for Evaporative System or misfire DTCs.

The MIL flashes when in Check Mode.

NOTE If the Diagnostic Tester switches the ECM from Normal Mode to Check Mode or vice-versa, or if the ignition switch is turned from ON to ACC or OFF during Check Mode, the DTC(s) and Freeze Frame data will be erased.

Step 7: Problem Symptom Confirmation

Using conditions described by the owner, check vehicle operation. Once the problem is verified, proceed to step 9 to see if any DTCs were recorded. If no symptoms were exhibited by the vehicle, proceed to step 8.

Step 8: Symptom Simulation

In this mode, as described in Section 1, an action is taken based on the description in the customer analysis sheet. For example, the condition occurs only when hot. Heating the component simulates the condition and may produce the fault.

Step 9: DTC Check

If there is a DTC, proceed to step 11.

If no DTCs are present, go to step 10.

Step 10: Basic Inspection

When the malfunction code is not confirmed in the DTC check, troubleshooting should be performed to narrow down the possibilities. In many cases, by carrying out the basic engine check shown in the Repair Manual under Basic Inspection, the location causing the problem can be found quickly and efficiently. Therefore, use of this check is essential in engine troubleshooting.

Basic Inspection Procedure

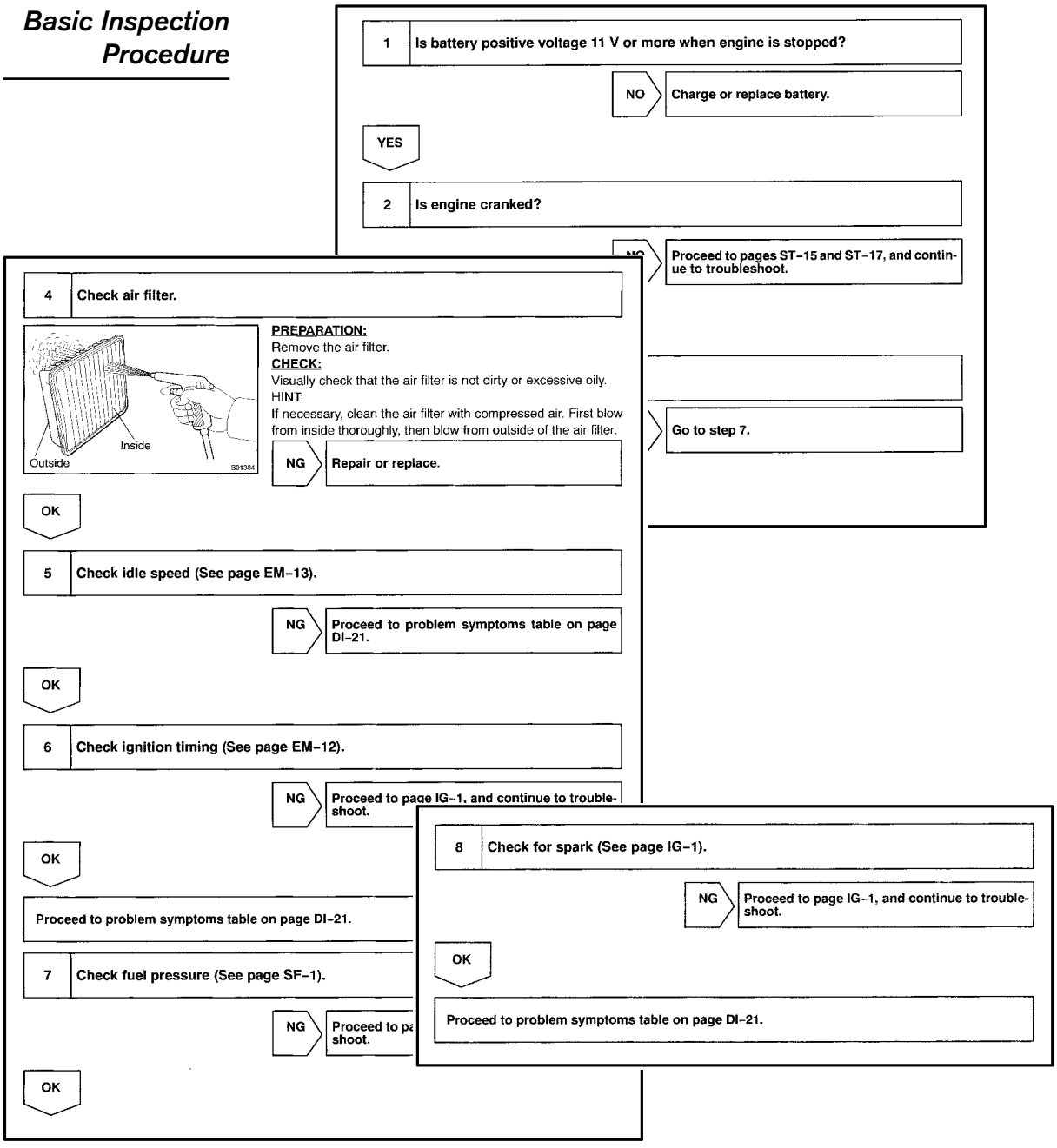


Fig. 2-22
TL874f222

Step 11: DTC Chart

The DTC chart lists DTC codes, what is detected, possible trouble areas, and what page to turn to in order to diagnose that DTC.

Step 12: Problem Symptoms Table

Use this table to troubleshoot the problem when a "NO" code is displayed in the diagnostic trouble code check but the problem is still occurring. Numbers in the table indicate the inspection order in which the circuits or parts should be checked.

Step 13: Circuit Inspection

Go to the circuit inspection for the DTC(s) listed and follow the procedure as outlined.

NOTE

Often overlooked by technicians are the Inspection Procedure, Hints and Circuit Descriptions. These areas contain valuable information on how the circuit operates, items to check, and the order to check these items.

Here is an example from the DTC P0440 section:

Inspection Procedure

Inspection Procedure:

HINT

- If DTC P0441, P0446, P0450 or P0451 is output after DTC P0440, first troubleshoot DTC P0441,P0446, P0450 or P0451. If no malfunction is detected, troubleshoot DTC P0440, next.

- Ask the customer whether, after the MIL came on, the customer found the fuel tank cap loose and tightened it. Also, ask the customer whether the fuel tank cap was loose when refueling. If the fuel tank cap was loose, it was the cause of the DTC. If the fuel tank cap was not loose or if the customer was not sure if it was loose, troubleshoot according to the following procedure.

- Read Freeze Frame data using the Diagnostic Tester, because Freeze Frame records the engine conditions when the malfunction is detected. When troubleshooting, it is useful for determining whether the vehicle was running or stopped, the engine was warmed up or not, or the A/F ratio was lean or rich, etc. at the time of the malfunction.

- When the ENGINE RUN TIME in the Freeze Frame data is less than 200 seconds, carefully check the vapor pressure sensor.

Step 14: Parts Inspection

The parts inspection procedures for engines and engine control system components are usually found in the following sections:

- •Engine Mechanical
- Fuel (Sequential Fuel Injection)
- Emission Control
- Ignition
- Engine Control System

Usually, the circuit inspection diagnosis routine will direct you to one of these sections.

The DI section has a Parts Location drawing showing the location of major engine control system components.

Step 15: Check for Intermittent Problems

Intermittent problems are often the most frustrating to solve. Aids to help you are:

- Using V-BoB
- Observing Mode 7 Continuous Tests or Pending Codes

By putting the vehicle's ECM in the check mode, one trip detection logic is possible instead of two trip detection logic; and sensitivity to detect open circuits is increased. This makes it easier to detect intermittent problems.

(1) Clear the DTC(s).
(2) Set the check mode.
(3) Perform a simulation test.
(4) Check the connector and terminal.
(5) Handle the connector.

NOTE Check mode does not work for EVAP DTCs.

Step 16: Adjustment/ Repair

At this point perform any adjustment or repairs.

Step 17: Confirmation Test

After repairing a problem involving many DTCs, the Repair Manual will outline a confirmation test procedure. It is very similar to using Check Mode. An alternative method is to use the Readiness Test Procedure using Mode 7.

Engine Operation Conditions Serial Data

In the DI section under ENGINE OPERATING CONDITION, there is a list that displays diagnostic tester abbreviations, the item measured, and what is a normal condition.

While not part of a specific routine, the listed items can provide important clues to engine operation and components and circuits operation.

If the measured item is not within the values given under normal condition, make a note but do not condemn the component or circuit. Always follow the troubleshooting procedure.

Engine Conditions - Serial Data

The values given for "Normal Condition" are representative values, so a vehicle may still be normal even if its value differs from those listed here. Do not decide whether a part is faulty according to the "Normal Condition" here.

hand-held tester display	Measurement Item	Normal Condition*
FUEL SYS #1	Fuel System Bank 1 OPEN: Air-fuel ratio feedback stopped CLOSED: Air-fuel ratio feedback operating	Idling after warming up: CLOSED
FUEL SYS #2	Fuel System Bank 2 OPEN: Air-fuel ratio feedback stopped CLOSED: Air-fuel ratio feedback operating	Idling after warming up: CLOSED
CALC LOAD	Calculator Load: Current intake air volume as a proportion of max. intake air volume	Idling: 15.6 - 22.2 % Racing without load (2,500 rpm): 16.6 - 23.9 %
COOLANT TEMP	Engine Coolant Temp. Sensor Value	After warming up: 80 - 95°C (176 - 203°F)
SHORT FT #1	Short-term Fuel Trim Bank 1	0 ± 20 %
LONG FT #1	Long-term Fuel Trim Bank 1	0 ± 20 %
SHORT FT #2	Short-term Fuel Trim Bank 2	0 ± 20 %
LONG FT #2	Long-term Fuel Trim Bank 2	0 ± 20 %
ENGINE SPD	Engine Speed	Idling: 650 - 750 rpm
VEHICLE SPD	Vehicle Speed	Vehicle stopped: 0 km/h (0 mph)
IGN ADVANCE	Ignition Advance: Ignition Timing of Cylinder No.1	Idling: BTDC 6 - 16°
INTAKE AIR	Intake Air Temp. Sensor Value	Equivalent to ambient temp.
MAF	Air Flow Rate Through Mass Air Flow Meter	Idling: 3.5 - 5.0 gm/sec. Racing without load (2,500 rpm): 12.5 - 17.9 gm/sec.
THROTTLE POS	Voltage Output of Throttle Position Sensor Calculated as a percentage: 0 V → 0 %, 5 V → 100 %	Throttle fully closed: 8 - 20 % Throttle fully open: 64 - 96 %
O2S B1 S1	Voltage Output of Oxygen Sensor Bank 1 Sensor 1	Idling: 0 - 1.0 V
O2S B1 S2	Voltage Output of Oxygen Sensor Bank 1 Sensor 2	Driving (50 km/h, 31 mph): 0 - 1.0 V
O2S B2 S1	Voltage Output of Oxygen Sensor Bank 2 Sensor 1	Idling: 0 - 1.0 V
O2S B2 S2	Voltage Output of Oxygen Sensor Bank 2 Sensor 2	Driving (50 km/h, 31 mph): 0 - 1.0 V
O2FT B1 S1	Oxygen Sensor Fuel Trim Bank 1 Sensor 1 (Same as SHORT FT #1)	0 ± 20 %
O2FT B2 S1	Oxygen Sensor Fuel Trim Bank 2 Sensor 1 (Same as SHORT FT #2)	0 ± 20 %

Fig. 2-23
TL874f223

Limitations of the Self-Diagnostic System

As advanced as the OBD and OBD II self diagnostic systems are, there are still certain limitations you must keep in mind when troubleshooting engine control system faults:

Not all engine control system circuits are monitored. Therefore, not all problems will activate the Malfunction Indicator Lamp (MIL) or store a DTC in ECM memory.

A DTC only indicates that a problem exists somewhere in the sensor/actuator circuit. You must determine where the fault exists. For example; a sensor, related wiring, or ECM. Some intermittent problems can go undetected because the diagnostic programming is unable to detect the fault. In these cases, it is best to use the problem symptoms, Basic Inspection, and get live measurements by using a DVOM or V-BoB.

Even though the engine control system passes the Diagnostic Circuit Inspection, it does not always indicate a problem free system.

Readiness Test Confirmation Strategy

This procedure uses the modes under CARB to detect problems with monitored systems. This procedure will guide you on how to use and interpret Readiness Confirmation Test status for diagnosis.

The Repair Manual often provides a confirmation driving pattern to test the vehicle, for certain types of repairs (O2 sensor, A/F sensor, EGR system, catalytic converter). The Repair Manual may direct you to use Check Mode. Check mode is NOT to be used. This procedure is a general procedure designed for all Non-Continuous monitors.

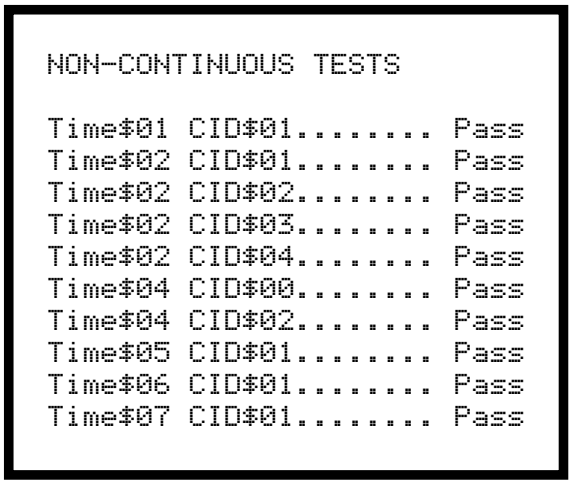
The following must be observed for the EVAP monitor to run and it must be within the following parameters:

- Vehicle must be cold, ambient temperature approximately between 10°C - 35°C (50°F - 95°F). (This is done for earlier completion.)
- Fuel level between 1/4 to 3/4 (this is done for earlier completion).
- Intake Air Temperature (IAT) and Engine Coolant Temperature (ECT) sensors within 6.5°C (12°F) of each other.

TID CID Screen and TIME$0 Screen

Two different screens showing Pass and Fail. Some vehicles will show TID in place of Time. To see the test results of the O2 sensor monitor, go to Mode 5 O2S Test Results.

- (TID)Time$01 = Catalyst Deterioration
- (TID)Time$02 = Evaporative System Deterioration
- (TID)Time$03 = Not Supported
- (TID)Time$04 = O2 Sensor Heater
- (TID)Time$05 = EGR
- (TID)Time$06 = A/F Sensor
- (TID)Time$07 = A/F Sensor Heater
- (TID)Time$08 = Thermostat Monitor



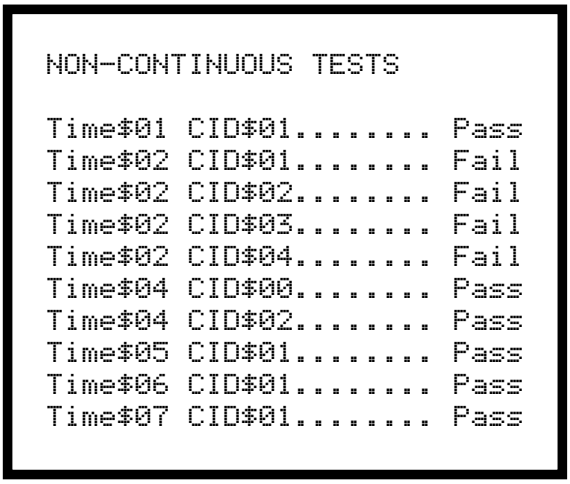


Fig. 2-24
TL874f215

First Trip Procedure

Clear DTCs. Under CARB OBD II, Readiness Tests will show INCMPL. Turn ignition key off, wait 5 seconds, then start the engine.

NOTE **The READINESS TEST screen and MONITOR STATUS screen contain identical information. You can use either screen to confirm monitor operation.**

First Trip Procedure - DTCs Cleared

All Non-Continuous Readiness Tests evaluations show INCMPL (incomplete) when DTCs are cleared. Monitor status will show the same monitors..

```
READINESS TEST

MISFIRE MON..... AVAIL
FUEL SYS MON..... AVAIL
COMP MON..... AVAIL
CAT EVAL..... INCMPL
HTD CAT EVAL..... N/A
EVAP EVAL..... INCMPL
2nd AIR EVAL..... N/A
A/C EVAL..... N/A
O2S EVAL..... INCMPL
O2S HTR EVAL..... INCMPL
EGR EVAL..... INCMPL
```

Fig. 2-25

TL874f225

Drive the vehicle in the following manner: Allow the engine to warm up. Moderately accelerate from 0 mph to 40 mph, hold at 40 mph for at least 30 seconds, then decelerate to idle with an idle time of approximately 30 seconds. Repeat this pattern at least three times. Next, drive the vehicle at a relatively constant speed between 40 mph to 65 mph. Avoid rough terrain and sharp turns. Note the state of Readiness Tests. They will change to **COMPL** as the evaluation monitors operate and if the system passes. This procedure may take approximately 20 minutes or more. **Do not shut off the engine – the results will be invalid.**

The following will explain the possible results of this test. The Diagnostic Tester will display either COMPL (complete) or INCMPL (incomplete). Read the following two conditions, **Pass Condition** or **Fail Condition** to determine the state of the monitor.

Pass Condition - No Problem Found by the ECM

If the evaluation monitor(s) shows **COMPL**, go to the NON-CONTINUOUS TESTS screen. To get there, go to ADVANCED OBD II, ON-BOARD TESTS, NON-CONTINUOUS TESTS. For the O2 sensor monitor, go to O2S TEST RESULTS.

NOTE Do not turn the engine off – the results will be invalid.

If the Time$0x tests show **Pass**, the evaluation monitor(s) **has operated and no problem was detected**.

Pass Condition

```
READINESS TEST

MISFIRE MON.......... AVAIL
FUEL SYS MON......... AVAIL
COMP MON............. AVAIL
CAT EVAL............. COMPL
HTD CAT EVAL......... N/A
EVAP EVAL............ COMPL
2nd AIR EVAL......... N/A
A/C EVAL............. N/A
O2S EVAL............. COMPL
O2S HTR EVAL......... COMPL
EGR EVAL............. COMPL
```

```
NON-CONTINUOUS TESTS

Time$01 CID$01........ Pass
Time$02 CID$01........ Pass
Time$02 CID$02........ Pass
Time$02 CID$03........ Pass
Time$02 CID$04........ Pass
Time$04 CID$00........ Pass
Time$04 CID$02........ Pass
Time$05 CID$01........ Pass
Time$06 CID$01........ Pass
Time$07 CID$01........ Pass
```

Fig. 2-26
TL874f226

No Determination Condition

If a Readiness Test shows **INCMPL**, go to NON-CONTINUOUS TESTS screen. For the O2 sensor monitor, go to O2S TEST RESULTS.

1.If the tests show **Pass**, the following may have occurred:

- the evaluation monitor did not operate
- the evaluation monitor did not finish
- the ECM withheld judgement

No Determination Condition

From the data on these two screens, the ECM has not determined if the EVAP system is good or if there is a problem. Further driving may be needd.

```
READINESS TEST

MISFIRE MON.......... AVAIL
FUEL SYS MON......... AVAIL
COMP MON............. AVAIL
CAT EVAL............. COMPL
HTD CAT EVAL............ N/A
EVAP EVAL............ INCMPL
2nd AIR EVAL............ N/A
A/C EVAL............... N/A
O2S EVAL............. COMPL
O2S HTR EVAL......... COMPL
EGR EVAL............. COMPL
```

```
NON-CONTINUOUS TESTS

Time$01 CID$01........ Pass
Time$02 CID$01........ Pass
Time$02 CID$02........ Pass
Time$02 CID$03........ Pass
Time$02 CID$04........ Pass
Time$04 CID$00........ Pass
Time$04 CID$02........ Pass
Time$05 CID$01........ Pass
Time$06 CID$01........ Pass
Time$07 CID$01........ Pass
```

Fig. 2-27
TL874f227

NOTE When a Readiness Test monitor shows INCMPL and Pass, it is unknown if the system monitor is good or if it has a problem. Further testing and/or driving is recommended to confirm system monitor operation.

Fail Condition - Problem Detected by the ECM

1. If one or more of the tests in the Time$0x... category show **Fail**, the evaluation monitor(s) did operate and the ECM detected a problem.

TID Screen

- (TID)Time$01 = Catalyst Deterioration
- (TID)Time$02 = Evaporative System Deterioration
- (TID)Time$03 = Not Supported
- (TID)Time$04 = O2 Sensor Heater
- (TID)Time$05 = EGR
- (TID)Time$06 = A/F Sensor
- (TID)Time$07 = A/F Sensor Heater
- (TID)Time$08 = Thermostat Monitor

Fig. 2-28

Fail Condition

Here, the ECM has detected a problem in the EVAP system. Since this happened on the first trip, the DTC(s) can be found in Continuous Tests (Mode 7) or Pending Codes. These are pending DTC(s).

```
READINESS TEST

MISFIRE MON.......... AVAIL
FUEL SYS MON......... AVAIL
COMP MON............. AVAIL
CAT EVAL............. COMPL
HTD CAT EVAL.......... N/A
EVAP EVAL............ INCMPL
2nd AIR EVAL.......... N/A
A/C EVAL.............. N/A
O2S EVAL............. COMPL
O2S HTR EVAL......... COMPL
EGR EVAL............. COMPL
```

```
NON-CONTINUOUS TESTS

Time$01 CID$01........ Pass
Time$02 CID$01........ Fail
Time$02 CID$02........ Fail
Time$02 CID$03........ Fail
Time$02 CID$04........ Fail
Time$04 CID$00........ Pass
Time$04 CID$02........ Pass
Time$05 CID$01........ Pass
Time$06 CID$01........ Pass
Time$07 CID$01........ Pass
```

Fig. 2-29

TL874f229

Go to CONTINUOUS TESTS (Mode 7) screen or PENDING CODES screen.

NOTE

Pending DTCs

The Continuous Tests or Pending Codes showed the DTCs. These DTCs do not show up anywhere else. These DTCs may not be valid, but indicates a possible problem. A second trip is needed to confirm.

```
CONTINUOUS TESTS
ECU: $10 (Engine)
Number of Tests: 3

P0440
EVAP Control System
Malfunction

P0441
EVAP Control System
Incorrect Purge Flow

P0446
EVAP Control System Vent
Control Circuit Malfunction
```

```
PENDING CODES
ECU: ENGINE
Number of DTCs: 3

P0440
EVAP Control System
Malfunction

P0441
EVAP Control System
Incorrect Purge Flow

P0446
EVAP Control System Vent
Control Circuit Malfunction
```

Fig. 2-30

TL874f230

Second Trip Procedure

The DTC listed may not be valid. A second trip is needed to confirm the DTC.

1. Vehicle must be cold, ambient temperature approximately between 10°C - 35°C (50°F - 95°F).
2. Fuel level between 1/4 to 3/4.
3. Intake Air Temperature (IAT) and Engine Coolant Temperature (ECT) sensors within 6.5°C (12°F) of each other.
4. **DO NOT CLEAR CODES!**
5. Go to Readiness Test screen.
6. Drive the vehicle according to the same pattern as outlined earlier. Note the state of evaluation monitor(s). This procedure may take approximately 20 minutes or more. **Do not shut off the engine – the results will be invalid.**

If a Readiness Test changes to **COMPL**, the evaluation monitor has operated. Check for any stored DTCs.

- If a DTC has stored, the problem has been detected and confirmed by the ECM.
- If no DTC was found, the monitor operated but no problem was detected.

There are situations where the Readiness Test may stay **INCMPL**, but the MIL will illuminate on the second trip (if two trip DTC). In this case, a fault has been detected and you should troubleshoot the displayed DTC(s).

Second Trip Procedure

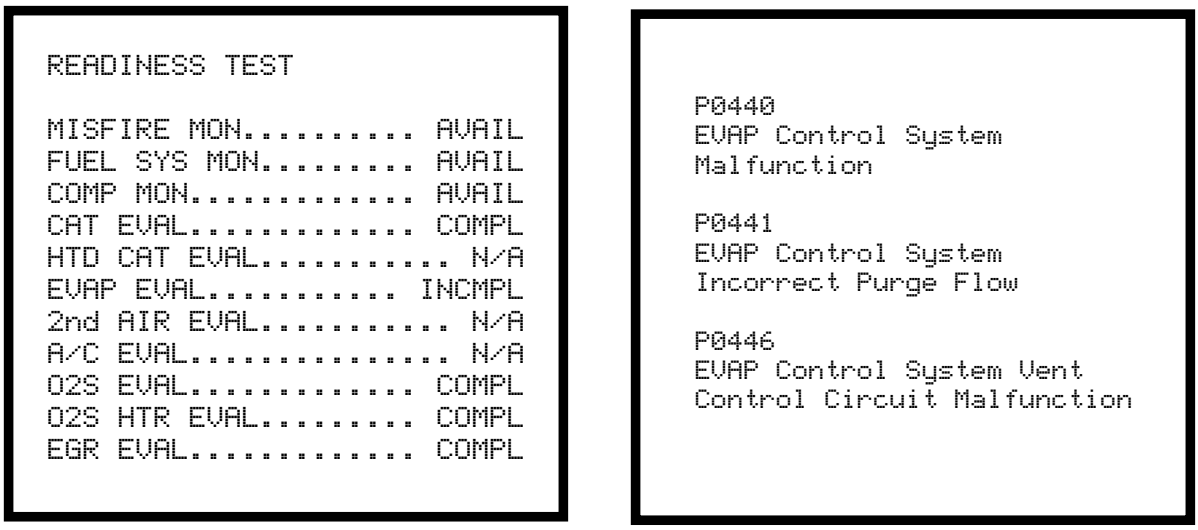


Fig. 2-31
TL874f231

Summary of Readiness Test Results

NO problem detected if the monitor shows COMPL on the first trip, and if Non-Continuous test screen shows Pass.

```
READINESS TEST

MISFIRE MON..... AVAIL
FUEL SYS MON..... AVAIL
COMP MON..... AVAIL
CAT EVAL..... COMPL
HTD CAT EVAL..... N/A
EVAP EVAL..... COMPL
2nd AIR EVAL..... N/A
A/C EVAL..... N/A
O2S EVAL..... COMPL
O2S HTR EVAL..... COMPL
EGR EVAL..... COMPL
```

```
NON-CONTINUOUS TESTS

Time$01 CID$01..... Pass
Time$02 CID$01..... Pass
Time$02 CID$02..... Pass
Time$02 CID$03..... Pass
Time$02 CID$04..... Pass
Time$04 CID$00..... Pass
Time$04 CID$02..... Pass
Time$05 CID$01..... Pass
Time$06 CID$01..... Pass
Time$07 CID$01..... Pass
```

The monitor did not operate/did not complete/withheld judgement -If monitor shows INCMPL on the first trip, and Non-Continuous Tests shows Pass.

```
READINESS TEST

MISFIRE MON..... AVAIL
FUEL SYS MON..... AVAIL
COMP MON..... AVAIL
CAT EVAL..... COMPL
HTD CAT EVAL..... N/A
EVAP EVAL..... INCMPL
2nd AIR EVAL..... N/A
A/C EVAL..... N/A
O2S EVAL..... COMPL
O2S HTR EVAL..... COMPL
EGR EVAL..... COMPL
```

```
NON-CONTINUOUS TESTS

Time$01 CID$01..... Pass
Time$02 CID$01..... Pass
Time$02 CID$02..... Pass
Time$02 CID$03..... Pass
Time$02 CID$04..... Pass
Time$04 CID$00..... Pass
Time$04 CID$02..... Pass
Time$05 CID$01..... Pass
Time$06 CID$01..... Pass
Time$07 CID$01..... Pass
```

Problem detected if the monitor operated and a fault was detected if the monitor shows INCMPL on the first trip, and Non-Continuous shows Fail. Go to Continuous Tests or Pending Codes for DTC(s).

```
READINESS TEST

MISFIRE MON..... AVAIL
FUEL SYS MON..... AVAIL
COMP MON..... AVAIL
CAT EVAL..... COMPL
HTD CAT EVAL..... N/A
EVAP EVAL..... INCMPL
2nd AIR EVAL..... N/A
A/C EVAL..... N/A
O2S EVAL..... COMPL
O2S HTR EVAL..... COMPL
EGR EVAL..... COMPL
```

```
NON-CONTINUOUS TESTS

Time$01 CID$01..... Pass
Time$02 CID$01..... Fail
Time$02 CID$02..... Fail
Time$02 CID$03..... Fail
Time$02 CID$04..... Fail
Time$04 CID$00..... Pass
Time$04 CID$02..... Pass
Time$05 CID$01..... Pass
Time$06 CID$01..... Pass
Time$07 CID$01..... Pass
```

```
CONTINUOUS TESTS
ECU: $10 (Engine)
Number of Tests: 3

P0440
EVAP Control System
Malfunction

P0441
EVAP Control System
Incorrect Purge Flow

P0446
EVAP Control System Vent
Control Circuit Malfunction
```

Fig. 2-32

TL874f232

Check Mode Procedure

(1) Initial conditions:

- Battery positive voltage 11V or more
- Throttle valve fully closed
- Transmission in P or N position
- A/C switched OFF

(2) Turn the ignition switch OFF.

(3) Prepare the Diagnostic Tester.

(4) Connect the Diagnostic Tester to the DLC3.

(5) Turn the ignition switch ON and push the Diagnostic Tester switch ON.

(6) Switch the Diagnostic Tester from the normal mode to the check mode (Check that the MIL flashes.)

NOTE If the Diagnostic Tester switches the ECM from the normal mode to the check mode or vice-versa, or if the ignition switch is turned from ON to ACC or OFF during the check mode, the DTC(s) and Freeze Frame data will be erased.

(7) Start the engine (The MIL goes out after engine start.)

(8) Simulate the conditions of the malfunction described by the customer.

NOTE Leave the ignition switch ON until you have checked the DTC(s), etc.

(9) After simulating the malfunction conditions, use the Diagnostic Tester diagnosis selector to check the DTC(s) and Freeze Frame data, etc.

NOTE Take care not to turn the ignition switch OFF. Turning the ignition switch OFF switches the diagnosis system from check mode to normal mode, so all DTC(s), etc., are erased.

(10) After checking the DTC, inspect the applicable circuit.

Notes

WORKSHEET 2-1
Diagnostic Tester Modes

Vehicle	Year/Prod. Date	Engine	Transmission

Worksheet Objectives

For troubleshooting OBD II concerns with the Diagnostic Tester, there are two major areas with information, Enhanced OBD II and CARB OBD II. In this worksheet, you will use the Diagnostic Tester to obtain relevant information, and observe the advantages different screens posses to the diagnosis of OBD II related concerns.

Tools and Equipment

- Vehicle Repair Manual
- Vehicle EWD
- Diagnostic Tester
- Hand Tool Set

Section 1: Features of Enhanced OBD II and CARB OBD II

1. On the list below, note if the listed item is located in the ENHANCED OBD II or CARB OBD II section. Write a very brief comment on the use/advantage of the following modes (if any).

SCREEN TITLE	ENHANCED OBD II	CARB OBD II
DATA LIST		
NORMAL MODE		
CHECK MODE		
REPAIR CONFIRMATION		
DTCs		

SCREEN TITLE	ENHANCED OBD II	CARB OBD II
SNAP SHOT		
FREEZE DATA		
CLEAR DIAG INFO		
O2S TEST RESULTS		
O2S/RPM CHECK		
READINESS TESTS		
ACTIVE TESTS		
ADVANCED OBD II FUNCTIONS		
NON-CONTINUOUS		
CONTINUOUS		
UNIT CONVERSION		
PENDING CODES		

Diagnostic Tester Modes

Name: _____ Date: _____

Review this sheet as you are doing the worksheet. Check each category after completing the worksheet and instructor presentation. Ask the instructor if you have questions. The comments section is for you to write where to find the information, questions, etc.

Topic	*I have questions*	*I know I can*	Comment
Locate Enhanced and CARB OBD II functions on the Diagnostic Tester			

Notes

WORKSHEET 2-2
Readiness Non-Continuous Test Modes

Vehicle	Year/Prod. Date	Engine	Transmission

Worksheet Objectives

To accurately diagnose the condition of the vehicle based on Readiness Tests and Non-Continuous Test modes.

CASE 1

DTCs were cleared and the vehicle was driven with the DT connected. Based on the following screen shots, determine the status of the Readiness Tests (monitors) and determine if there is a problem

```
READINESS TEST

MISFIRE MON.......... AVAIL
FUEL SYS MON......... AVAIL
COMP MON............. AVAIL
CAT EVAL............. COMPL
HTD CAT EVAL........... N/A
EVAP EVAL............ COMPL
2nd AIR EVAL........... N/A
A/C EVAL............... N/A
O2S EVAL............. COMPL
O2S HTR EVAL......... COMPL
EGR EVAL............. COMPL
```

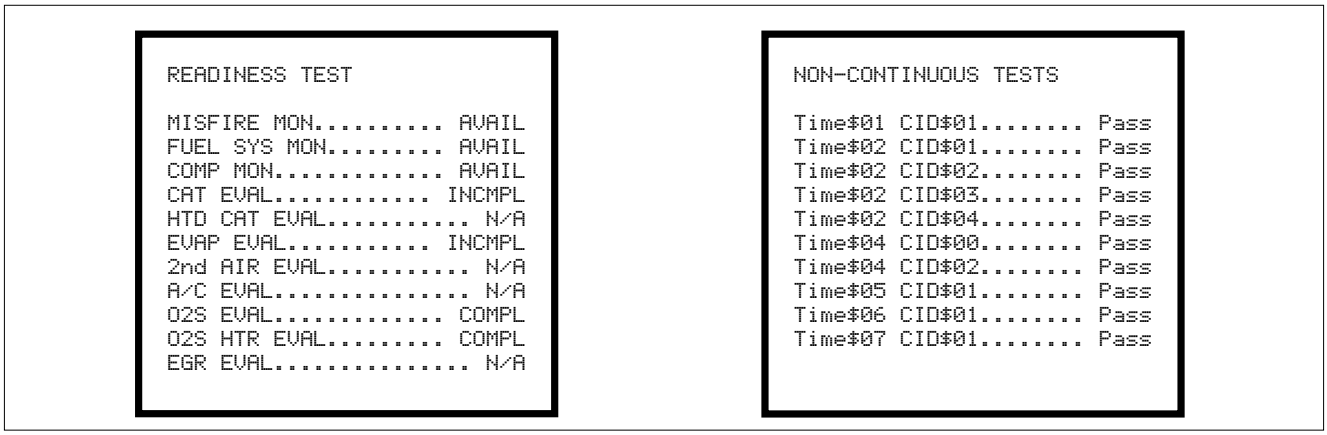
```
NON-CONTINUOUS TESTS

Time$01 CID$01........ Pass
Time$02 CID$01........ Pass
Time$02 CID$02........ Pass
Time$02 CID$03........ Pass
Time$02 CID$04........ Pass
Time$04 CID$00........ Pass
Time$04 CID$02........ Pass
Time$05 CID$01........ Pass
Time$06 CID$01........ Pass
Time$07 CID$01........ Pass
```

READINESS TEST MON	Operate?	Status?
MISFIRE MON		
FUEL SYS MON		
COMP MON		
CAT EVAL		
EVAP EVAL		
O2S EVAL		
O2S HTR EVAL		
EGR EVAL		

Notes:

CASE 2

DTCs were cleared and the vehicle was driven with the DT connected. Based on the following screen shots, determine the status of the Readiness Tests monitors and determine if there is a problem.

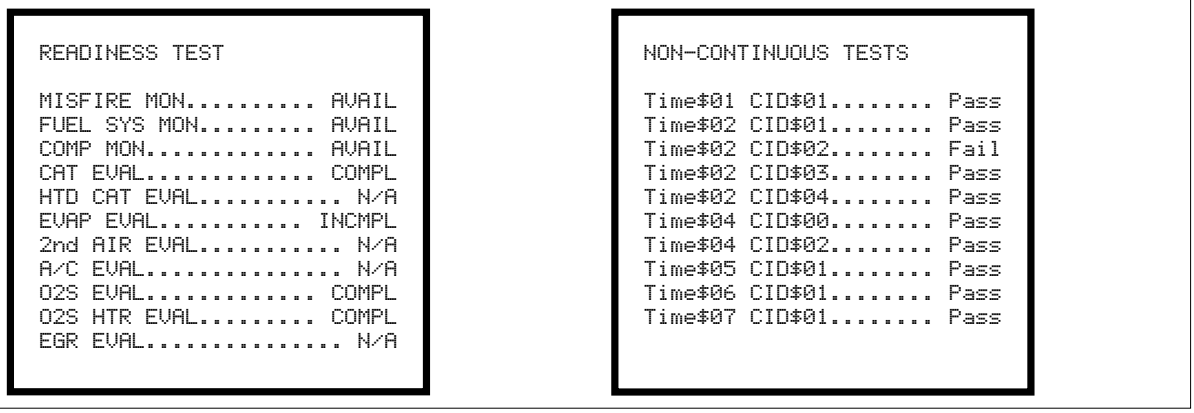


READINESS TEST MON	Operate?	Status?
MISFIRE MON		
FUEL SYS MON		
COMP MON		
CAT EVAL		
EVAP EVAL		
O2S EVAL		
O2S HTR EVAL		
EGR EVAL		

Notes:

CASE 3

DTCs were cleared and the vehicle was driven with the DT connected. Based on the following screen shots, determine the status of the Readiness Tests monitors and determine if there is a problem.



READINESS TEST MON	Operate?	Status?
MISFIRE MON		
FUEL SYS MON		
COMP MON		
CAT EVAL		
EVAP EVAL		
O2S EVAL		
O2S HTR EVAL		
EGR EVAL		

Notes: